

X-ray Reflectivity Measurements of the Temperature-Dependent Roughening Exponent β for the Growth of Cu on Cu(001)

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Abstract No. bote5320

Beamline(s): X3B2

X-ray scattering has been used to study kinetic roughening of the Cu(001) surface during homoepitaxial growth. The coverage dependence of the root-mean-square (rms) roughness, σ , obtained from reflectivity data, was measured for temperatures between 160K and 370K. **Figure 1.a** shows the specular reflectivity from a clean Cu(001) surface as well as for three different coverages: $\Theta = 6\text{ML}$, $\Theta = 24\text{ML}$ and $\Theta = 96\text{ML}$, at a temperature of 300K. The data (open symbols) were obtained from transverse scans across the specular rod, for an extended range of values of the perpendicular momentum transfer Q_z . The solid lines are best fits to a real-space model that accounts for the roughness of the surface. The rms roughness resulting from the fits was found to increase as a power law $\sigma = \Theta^\beta$ for coverages between 3 and 96ML. This result is shown in **Figure 1.b**. A power law dependence of σ on the coverage was observed at all temperatures used in this study. The roughening exponent, β , depends on the temperature of the substrate. As shown in **Figure 1.c**, $\beta \approx 1/2$ at low temperatures ($T \leq 200\text{K}$), while above 200K β monotonically decreases, reaching $1/3$ at $T = 370\text{K}$. This behavior differs from the findings of a previous helium-atom scattering measurement where β was found to decrease as the temperature was lowered from 200 to 160K.

Support is acknowledged from the NSF, under contract DMR-9623827 and MISCON under DOE grant DE-FG02-90ER45427. The SUNY X3 beam line is supported by the DOE, under contract DE-FG02-86ER45231 and the NSLS is supported by the DOE, Division of Material Sciences and Division of Chemical Sciences.

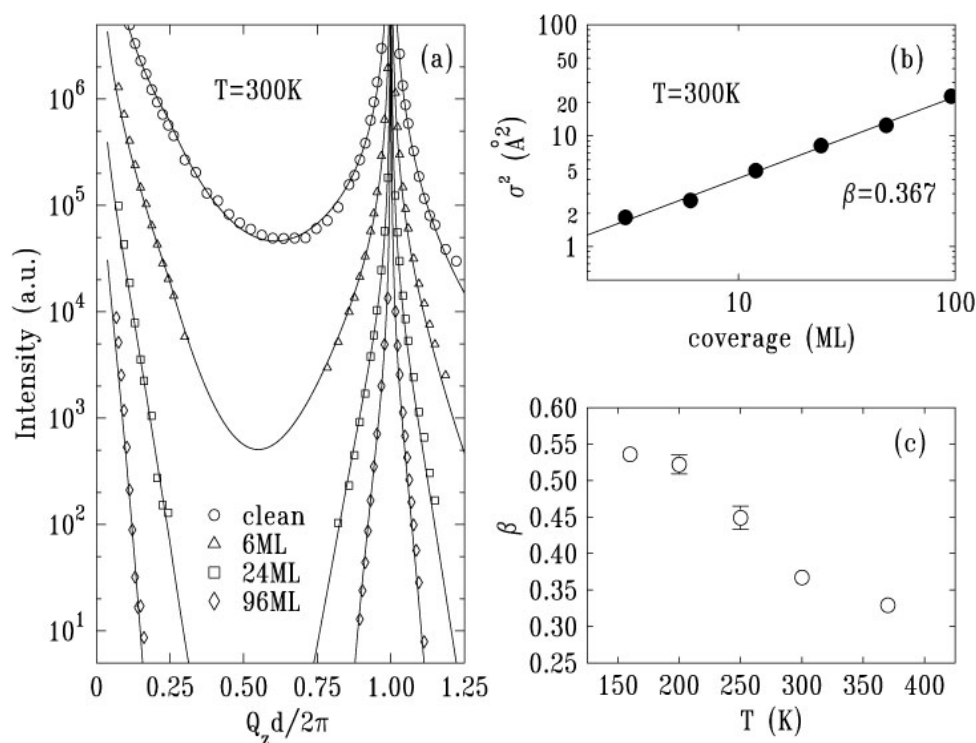


Figure 1. (a) The specular reflectivity lineshape changes with the amount of deposited material, as the Cu(001) surface roughens at $T = 300\text{K}$. (b) The mean-squared roughness increases as a power law with the coverage. (c) The roughening exponent, β , depends on the temperature of the substrate.